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[54] **WIRE WRAPPING TOOL**

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[51] **Int. Cl.**[2] **B21F 15/04**

[58] **Field of Search** 140/119, 122, 124, 115; 242/7.17

[56] **References Cited**

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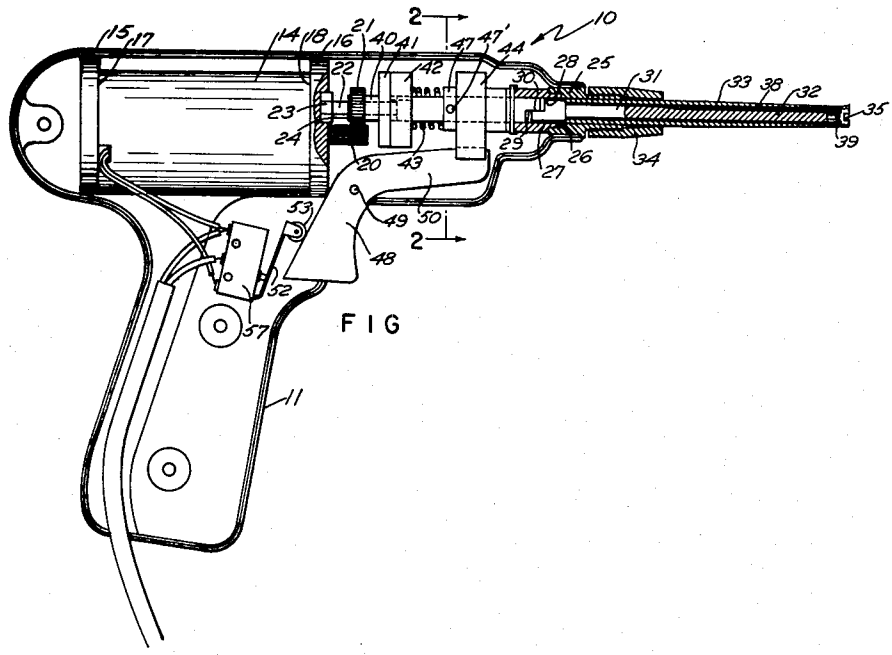
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[57] **ABSTRACT**

A power driven tool for making a solderless connection between a wire and an electric terminal by wrapping the wire in successive convolutions about and in intimate engagement with the terminal. A wrapping bit of the tool is indexed to the proper point for quick easy insertion of the wire and operates positively and quickly for a complete wrapping cycle.

10 Claims, 5 Drawing Figures



FIG

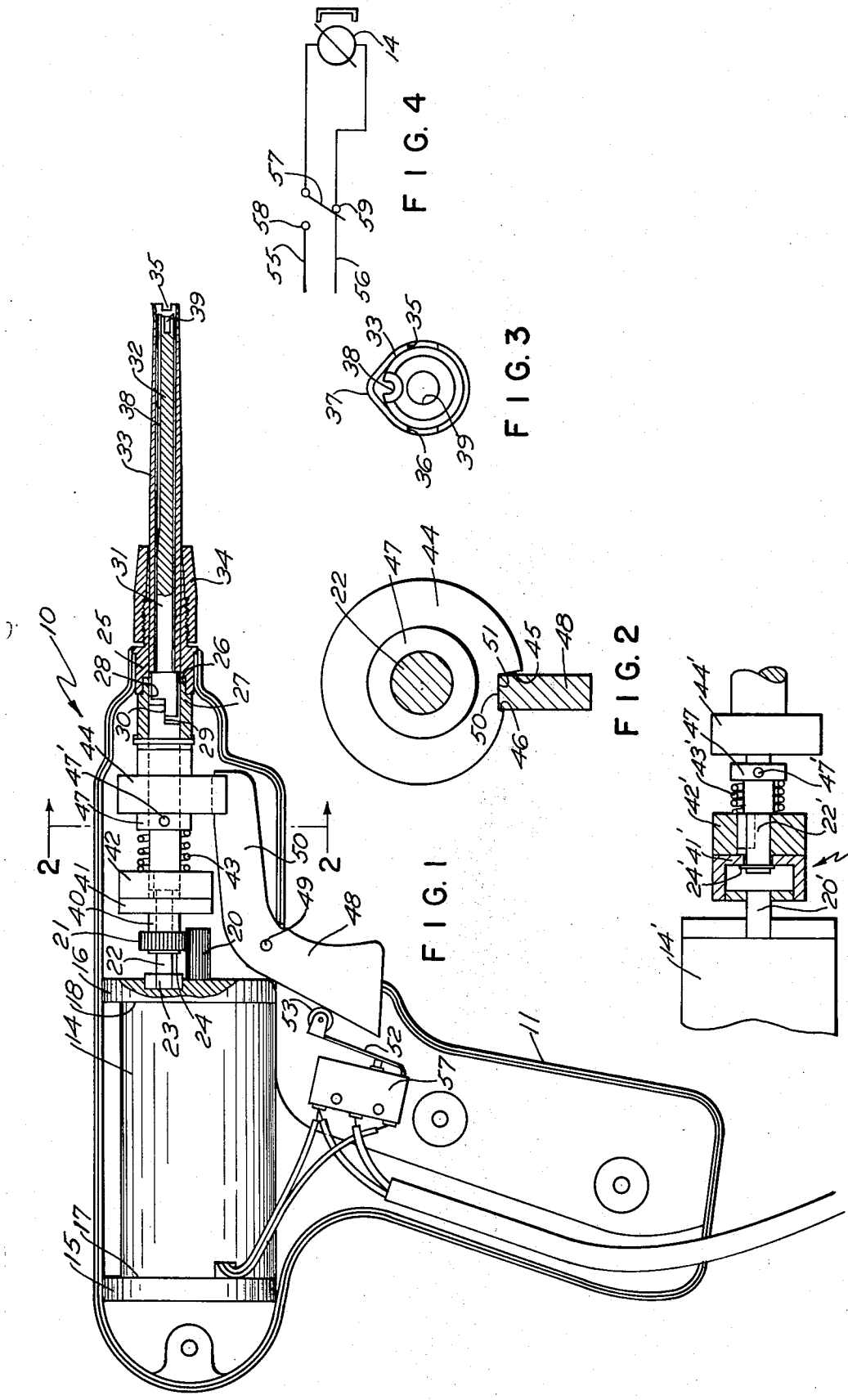


FIG. 1

FIG. 2

FIG. 3

FIG. 4

FIG. 5

WIRE WRAPPING TOOL

BACKGROUND OF THE INVENTION

In many hand-held wire wrapping tools there is consumption of time in threading the wire into the tool because the bit does not index to the required location and must be hand manipulated prior to threading. There have been pneumatic and electric tools utilized and also indexing mechanisms as illustrated in U.S. Pat. No. 3,219,067. Such indexing mechanisms depend upon loading of a spring to reverse the rotation of the bit bringing it to a certain location by use of the loaded spring. This may unwrap the last turn of wire, is often uncertain, and springs may fatigue.

In U.S. Pat. No. 3,717,183 indexing is provided by a roller bearing on a spring-loaded trigger, the spring pressure of the trigger forcing back an indented cam with a lesser spring pressure, which cam is coupled to the drive shaft, the roller bearing rolling around as the cam continues to turn from inertial force until the bearing seats in the indent of the cam. This causes the trigger and operator's finger to annoyingly bounce until the inertial force has stopped. This device also causes a high trigger pressure to be applied by the operator due to the engagement and higher pressure disengagement spring mechanisms.

Further, tests of prior devices have shown that tool weight, balance and trigger pressure in particular have an effect on the operator's "feel" and quality of the wrapped connection. Too much pressure against the tool causes the turns of wire to overwrap one another and not enough pressure causes the turns of wire to be spaced too far apart to provide a satisfactory mechanically tight connection.

Assuming that the tool is light enough in weight and balanced properly, if the pressure to actuate the trigger is in the range of 16 ozs. and higher, the tendency is to press too hard against the turns of wire causing the above mentioned rejectable overwraps, especially on smaller gage wire such as 28 and 30 gage wire.

For this reason, most manufacturers sell what are called "anti-backforce" devices, a spring loaded device to be installed in their tool in back of the rotating bit for a particular wire gage. This allows the bit to recede rather than the wire to be overwrapped when the operator exerts too much pressure on the tool. Besides the additional cost of the device for each wire gage or two, almost complete disassembly of the tool is required to install the device.

Motors which operate a wire wrapping tool usually rotate about 13 thousand revolutions, per minute. Gearing then reduces this to about 4,500 revolutions per minute. Considerable inertia is developed at these speeds and if a positive stop is inserted for indexing, large stresses occur and breakage is frequent and trials have found this to be unseccessful and have rejected this type of operation.

SUMMARY OF THE INVENTION

The concepts of this invention are not only to provide a drive and index mechanism which allows the tool to go from high speed to an abrupt stop at a fixed position repetitively within ±5° without damage to the gear train or other parts of the tool, but also to provide a drive and index mechanism that does not require some part of the driving mechanism to be engaged and disengaged thereby causing a higher trigger pressure and

the need for anti-backforce devices, As the speed of the cycle (r.p.m., index stop and loading) constitutes the number of connections per hour and hence the labor cost, the wire wrapping tool must go from full wrap speed to an index stop almost instantaneously.

The speed and weight of the driving shaft, motor shaft, rotating bit and any attachments thereto naturally build up a considerable inertial force as they are rotating, which then must be abruptly stopped. This abrupt stop can generate great harm and damage to the gear train and other components.

In carrying forth the concepts, the present invention comprises a housing with a pistol grip handle, and extending from the housing is a rotatable bit disposed in a tubular sleeve, the bit having a longitudinally extending bore in its forward end for the reception of a terminal post on which the wire is to be wrapped, and there is a radially offset longitudinal groove for the reception of the wire. In one version a permanent magnet electric motor having means to provide a dynamic brake, is disposed in the housing for driving the bit. A trigger operated switch controls the motor. The electric current drives the motor in one direction by closing this switch and when the trigger is released, the motor is shorted so that it acts as a generator driven by the inertia of the bit and its driving mechanism, providing the power for this generator and thus a braking action occurs to bring the motor to a stop. Some abutment is provided so that when the trigger is released, the trigger will be in the path of this abutment to be engaged and thus index or locate the bit in a desired position. When such a stop is engaged the bit will maintain a position against the stop and not bound back or move in the opposite direction to position the bit out of line. After the abutment is engaged, a clutch permits further rotation of the motor and driving gears until the driving inertia is expended, thus relieving strain on the driving gears.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a half section of the casing showing some of the driving parts in section;

FIG. 2 is a sectional view through the trigger stop on line 2—2;

FIG. 3 is an enlarged end view of the bit and sleeve;

FIG. 4 is a view illustrating the electrical circuit for the motor; and

FIG. 5 is a view similar to FIG. 1 showing a modification of the drive.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring particularly to FIG. 1 a housing designated generally **10** has a pistol grip portion **11** shaped as illustrated in the drawing. A motor **14** having a dynamic brake has secured to its opposite ends at **15** and **16** elastomeric members of a diameter a little greater than the diameter of the motor **14** so as to space the motor from the side walls of the circular type casing which embraces the motor. Stops at **17** and **18** molded in the casing engage the ends of the elastomeric members **15** and **16** so as to prevent the motor from axial or radial movement in the casing. The motor is the heaviest part of the instrument and if dropped places a strain on the parts of the casing which mount it, but by use of the elastomeric members engaging the casing at spaced points and the stops which are molded into the casing, the load from such dropping is distributed over the cas-

ing and will withstand much greater forces than molding into the casing some fins upon which such strains occur.

The armature shaft of the motor is fitted with a gear **20** which engages gear **21** on drive shaft **22,** which shaft has a stud portion **23** which engages a bearing formed in the elastomeric member **16.** An annual part of a collet **25** is secured in the end of the casing **10** and provides a bearing at **26** for a coupling **27** which is recessed as at **28** and provided with a flat surface **29** that engages a similar flat surface **30** on the bit **31** which is elongated as at **32** to extend through a sleeve **33** which sleeve is clamped by nut **34** on the collet **25** so as to cause it to remain fixed with relation to the casing as the bit **31** is driven. This sleeve **33** is notched as at **35** and **36** (FIG. **3**) and is expanded as at **37** so as to provide an entrance mouth for a wire to be passed into the groove **38** in the bit **32.** Then this wire may be bent outwardly into one of the notches **35** or **36** while the pin or post upon which the wire is to be wrapped is inserted in the hole **39** in the bit.

The gear **21** from which a hub **40** extends with a disc **41** secured to the hub comprises a unit which is free to rotate on a shaft **22** and is driven by the gear **20** on the armature shaft. This unit is limited in its movement axially of shaft **22** by a stop **24,** such as a snap ring. A disc **42** is keyed to the shaft **22** to axially slide thereon and rotate therewith, and it has a face, which may be polyurethane, to engage the face of the disc **41** so that when pressed into engagement with the disc **41** by the spring **43,** the shaft **22** will be driven. Spring **43** is precalculated to supply pressure against disc **42** to cause sufficient friction between the faces of discs **41** and **42** for driving one from the other. A driving friction is between the disc faces and not between spring **43** and disc **42** or spring **43** and collar **47.** Disc **42** is keyed to shaft **22** to prevent relative circular movement of disc **42.** This also permits the use of a lower spring pressure as the surface area of the two disc faces is greater than the surface area of spring **43** and disc **42** or spring **43** and shoulder **47** and if disc **42** were not keyed slippage could take place other than between the disc faces.

A mechanical stop such as collar **47** is applied to shaft **22.** This collar may be axially adjusted along shaft **22** and held by set screw **47'**. The distance of this mechanical stop **47** from the other end of disc **42** determines the compressed length of spring **43** and the pressure exerted, which in turn creates the friction between the disc faces. This pressure is precalculated so as to provide rotating bit **31** with sufficient torque to wrap the heaviest gage wire required.

As it is advantageous for one tool to be able to wrap US 20 gage thru US 30 gage wire, tests were run to determine that 20 gage wire requires approximately 2-inch lbs. of torque from the rotating bit **31** and spring pressures (compressed length) were determined so as to provide that amount of torque. If a tool were only to be used for US 30 gage wrapping, a lesser torque would be required and hence lower spring pressure and friction. Therefore, the compressed length of spring **43** (if the same load rate spring were used) would be lessened by lengthening the distance between mechanical stop **47** and the disc **42** or a spring of lesser load rate could be used.

Of considerable importance is that mechanical stop **47** and retaining ring **24** in FIG. **1** restrain all spring pressure between them so that no pressure is exerted axially on bearing surface **26** or **23** in FIG. **1,** as axial pressure on bearing or other surfaces can reduce torque output of a tool and cause premature bearing surface wear, the index and drive mechanism described above eliminates such condition and requires only motor power sufficient to achieve the desired torque.

Also secured to the shaft **22** is a cam **44** which is notched to provide an abutment **45** for the reception of the portion **50** of the trigger **48.** The notch **51** extends into the surface of the cam so that there is also provided an abutment **46** of lesser extent to prevent any rebound when the abutment **45** engages the abutment **50** of the trigger **48.** A trigger **48** as shown in FIG. **1** is pivoted as at **49** and has a portion **50** to extend into the path of abutment **45** when it is rotating and when the trigger is in its released position. The trigger is moved to its release position by spring means within switch **57** which is transmitted to the trigger by a leaf **52** and roller **53.** Auxiliary spring means may be provided as necessary. Notch **51** in cam **44** is in radial relationship to tang driver **29** housed in bearing or nose piece **27** so as to position rotating bit **31** in the desired position, usually 12 o'clock when the tool is held in an upright position. When the motor **14** is energized, the motor shaft, drive shaft and all attachments thereto rotate at the speeds described. The inertial force now becomes greater than the set torque force and when the front area **50** of trigger **48** contacts high abutment **45** of cam **44,** it stops disc **42,** shaft **22** and rotating bit **31** in the desired position, however, gears **20** and **21** and coupling and/or disc **41** keep on rotating until the inertial force has subsided to a force equal to or less than the torque force. In this manner, no strain greater than the gears were designed for is ever imparted to them by the abrupt stop of the high inertial force.

Referring now to FIG. **4** the source of power is designated **55** and **56** and single-pole double-throw switch **57,** when on terminal **58,** will drive the motor **14** in the direction to rotate the bit. However, when in released position, the switch **57** contacts terminal **59** so as to in effect short the motor **14,** disconnecting the drive of the motor and thus the inertia of the motor and the parts connected thereto cause the motor to act as a generator or in other words exert a braking action on the motor to cause its armature shaft to come to a stop. This movement of the switch arm **57** to contact **59** is caused when the trigger **48** is released and as this trigger **48** is released the portion **50** of the trigger moves into the path of the abutment **45** to stop the bit to which this stop is connected at the desired location for a threading of another wire into the tool.

In FIG. **5** a direct drive from the motor is shown. The motor **14'** is equipped with a cluster type gear head with a drive shaft **20'** extending therefrom. A coupling **21'** has a disc **41'** which is fixed to the shaft **20'** to be rotated thereby but is freely rotatable on shaft **22'** which extends through the disc **41'**. A stop **24'** limits axial movement of the disc **41'**on shaft **22'**. Shaft **22'** has keyed thereon disc **42'** which is axially slidable on shaft **22'** and urged into face-to-face contact with disc **41'** by spring **43'** in the manner described with reference to FIG. **1** and the operation is otherwise the same as the showing in FIG. **1.**

The mechanisms above described are electrically driven, however, an air driven motor may be used in which a spring loaded air valve may be manipulated by the trigger **48** in place of the control **57** shown in FIG.

1 as, for example, as disclosed in U.S. Pat. No. 3,318,344. In either case, the clutch mechanism operates the same.

I claim:

1. A wire wrapping tool comprising
1. a rotary bit
2. a motor
3. a friction clutch having two faces slidably and continuously in engagement through which said motor drives said bit
4. indexing means operably connected to said bit and having an angular index position related to an angular position of said bit
5. control means for said motor which in one position energizes the motor and in another position operates said indexing means.

2. A wire wrapping tool as in claim **1** wherein said clutch is face to face frictional engagement with means to adjust the frictional force.

3. A wire wrapping tool as in claim **2** wherein one clutch face is coupled to the motor and the other face is coupled to the bit, and the friction is adjustable so that when the indexing means operates to stop the one clutch face and the bit, the other of the clutch faces and the motor may continue to rotate until the inertia of the parts is spent.

4. A wire wrapping tool as in claim **3** wherein said motor is electrical and dynamic braking means for said motor is present.

5. A wire wrapping tool as in claim **1** wherein said clutch comprising a face to face friction relation of two members with one member having a part in axial sliding relation with a part of the other member, said sliding relation being limited by a pair of stop means and means acting between said stop means to urge said friction faces against one of said stop means, said one stop being on the driven side of said clutch whereby no axial thrust is imparted to the drive side of said clutch.

6. A wire wrapping tool comprising
1. an electric motor,
2. dynamic braking means for said motor,
3. a rotary bit,
4. means for driving the rotary bit from said motor,
5. indexing means operably connected to said bit, said indexing means having an angular index position related to an angular position of the bit,
6. control means for said motor including said dynamic braking means which in one position energizes said motor and in a second position de-energizes the motor and connects said dynamic braking means and operates said indexing means.

7. A wire wrapping tool as in claim **6** wherein
7. said indexing means comprises a stop, and
8. said control means includes a member to engage said stop when in de-energizing position.

8. A wire wrapping tool as in claim **6** wherein
7. said indexing means comprising a stop, and
8. said control means includes a member to engage said stop when in de-energizing position whereby when said stop is engaged by said member it is held in a desired indexing position.

9. A wire wrapping tool as in claim **6** wherein there is a casing about said motor, and elastomeric members in spaced relation support said motor in said casing to distribute an impact load therealong.

10. A wire wrapping tool as in claim **6** wherein there is a casing about said motor, elastomeric members in spaced relation support said motor in said casing to distribute an impact load therealong, abutment means carried by said casing engaging said elastomeric members to limit movement of said motor.

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